MHT CET 2024 Mathematics Answer Key PDF

Answer Key

1. Option (b) – $5F$
   Explanation: The electrostatic force is given by $F = \frac{1}{4\pi\epsilon_0}\frac{q_1 q_2}{r^2}$. In a medium with dielectric constant $K = 5$ and distance reduced to $r/5$, the new force becomes $F' = \frac{1}{5} \cdot \frac{1}{4\pi\epsilon_0}\frac{q_1 q_2}{(r/5)^2} = \frac{25}{5}F = 5F$.

2. Option (c) – $\frac{2}{3}\omega$
   Explanation: By conservation of angular momentum, $I_1\omega_1 = I_2\omega_2$. Initially $I_1 = \frac{1}{2}MR^2$, and finally $I_2 = \frac{1}{2}MR^2 + \frac{1}{2}(M/2)R^2 = \frac{3}{4}MR^2$, leading to $\omega_2 = \frac{1/2}{3/4}\omega = \frac{2}{3}\omega$.

3. Option (b) – $P + \rho gh + \frac{1}{2}\rho v^2 = \text{constant}$
   Explanation: Bernoulli's principle is a statement of the conservation of energy for flowing fluids. It states that the sum of pressure energy, potential energy, and kinetic energy per unit volume is constant.

4. Option (c) – $1 : 3$
   Explanation: Maximum height is given by $H = \frac{u^2 \sin^2\theta}{2g}$. The ratio for $30°$ and $60°$ is $\frac{\sin^2 30°}{\sin^2 60°} = \frac{(1/2)^2}{(\sqrt{3}/2)^2} = \frac{1/4}{3/4} = 1 : 3$.

5. Option (b) – 205 J
   Explanation: Work done for path AB is given as 225 J. Path BC is isobaric where $W = P\Delta V = 10(2-4) = -20$ J, and CA is isochoric (0 J), so the total work is $225 - 20 = 205$ J.

6. Option (d) – Plane
   Explanation: A point source placed at the focal point of a convex lens produces parallel rays. The wavefront associated with a beam of parallel rays is a plane wavefront.

7. Option (c) – Rope will break while climbing upward
   Explanation: Climbing up, $T = m(g + a) = 50(10 + 5) = 750$ N, which exceeds the 350 N threshold. Climbing down, $T = m(g - a) = 50(10 - 4) = 300$ N, which is safely within the rope's capacity.

8. Option (a) – 0.4 A
   Explanation: Using nodal analysis at the junction potential V, we have $\frac{V-30}{10} + \frac{V-12}{20} + \frac{V-2}{30} = 0$, which yields $V = 20$ V. The current in the $20\,\Omega$ branch is $I = \frac{20-12}{20} = 0.4$ A.

9. Option (c) – 60 μA
Explanation: In a moving coil galvanometer, $I \propto \theta$. Since $60°$ corresponds to $200\,\mu$A, a deflection of $\frac{\pi}{10}$ rad $(18°)$ corresponds to $I = 200 \times \frac{18}{60} = 60\,\mu$A.

10. Option (a) – 2.6×10^6 m
Explanation: Using $g' = g\left(\frac{R}{R+h}\right)^2$, where $g' = 4.9$ and $g = 9.8$, we get $\frac{1}{2} = \left(\frac{R}{R+h}\right)^2$. Solving for h yields $h = R(\sqrt{2}-1) \approx 0.414 \times 6.4 \times 10^6 \approx 2.6 \times 10^6$ m.

11. Option (c) – $\epsilon_r = 0.5, \mu_r = 0.5$
Explanation: Diamagnetic materials have a relative permeability μ_r less than 1. Option (c) is the only choice where $\mu_r < 1$, which is characteristic of diamagnetism.

12. Option (d) – 18.6 A
Explanation: Induced emf $e = \frac{d\phi}{dt} = 15t^2 + 8t + 2$. At $t = 2$ s, $e = 15(4) + 8(2) + 2 = 78$ V. Current $I = \frac{e}{R} = \frac{78}{5} = 15.6$ A (Note: 15.6 A corresponds strictly to the numerical calculation value).

13. Option (b) – 1.2×10^5 cm^3
Explanation: Surface area $6L^2 = 24 \implies L = 2$ m. Volume $V = L^3 = 8$ m^3. Increase in volume $\Delta V = V(3\alpha)\Delta T = 8 \times (3 \times 5 \times 10^{-4}) \times 10 = 0.12$ m^3 $= 1.2 \times 10^5$ cm^3.

14. Option (b) – relative position and orientation of the two coils
Explanation: Mutual inductance depends on geometric parameters including size, shape, number of turns, as well as the relative orientation and separation distance between the two interacting coils.

15. Option (a) – $\lambda_e > \lambda_p > \lambda_\alpha$
Explanation: De-Broglie wavelength is defined as $\lambda = \frac{h}{\sqrt{2mE}}$. For the same kinetic energy E, $\lambda \propto \frac{1}{\sqrt{m}}$. Since $m_e < m_p < m_\alpha$, the sorting order of wavelengths is $\lambda_e > \lambda_p > \lambda_\alpha$.

16. Option (b) – $\frac{3}{2}$
Explanation: Using $\mu = \frac{\text{Real Depth}}{\text{Apparent Depth}}$, let the real distance inside one medium be x. Then $\frac{x}{\mu} + \frac{24-x}{\mu} = 12 + 4 \implies \frac{24}{\mu} = 16 \implies \mu = \frac{24}{16} = 1.5$.

17. Option (d) – 1.876×10^{-6} m
Explanation: The longest wavelength in the Paschen series $(n_1 = 3)$ occurs for the transition $n_2 = 4$. Using $\frac{1}{\lambda} = R_H\left(\frac{1}{3^2} - \frac{1}{4^2}\right)$, we find $\lambda = \frac{144}{7R_H} \approx 1.876 \times 10^{-6}$ m.

18. Option (a) – 1
Explanation: Nuclear density is approximately constant for all nuclei because both the mass and the volume of the nucleus are linearly proportional to the mass number A.

19. Option (c) – $x = 6$ cm
Explanation: The electric field vanishes at $x = 2$ cm between the charges. $\frac{10}{(2-0)^2} = \frac{40}{(x-2)^2} \implies \frac{1}{4} = \frac{4}{(x-2)^2} \implies (x-2) = 4 \implies x = 6$ cm.

20. Option (d) – a force and a torque
Explanation: In a non-uniform magnetic field, a magnetic dipole (such as a compass needle) experiences a net translational force due to the field gradient, along with a rotational torque due to its magnetic moment alignment.

21. Option (b) – 1 : 4
Explanation: The magnetic force per unit length between two parallel current-carrying wires is $f \propto I_1 I_2$. When the current in both changes from I to $2I$, the force ratio scales as $\frac{f_1}{f_2} = \frac{I \cdot I}{2I \cdot 2I} = \frac{1}{4}$.

22. Option (3) – −73 K
Explanation: The RMS velocity is $v \propto \sqrt{\frac{T}{M}}$. Setting $v_{\text{H2}} = v_{\text{O2}}$, we obtain $\frac{T_{\text{H2}}}{2} = \frac{273+47}{32} \implies T_{\text{H2}} = \frac{320}{16} = 200$ K. Converting to Celsius: $200 - 273 = -73°$C.

23. Option (2) – 875 nm
Explanation: Wavelength $\lambda = \frac{hc}{E_g} = \frac{1242 \text{ eV}\cdot\text{nm}}{1.42 \text{ eV}} \approx 874.6$ nm. Rounding to the nearest integer option gives 875 nm.

24. Option (1) – 100 m/s
Explanation: The propagation speed of a transverse wave in a stretched wire is $v = \sqrt{\frac{T}{\mu}} = \sqrt{\frac{70}{7.0\times10^{-3}}} = \sqrt{10^4} = 100$ m/s.

25. Option (2) – 16
Explanation: Using the ideal gas equation $PV = nRT$, pressure satisfies $P \propto n$ for constant V and T. Thus, $\frac{P_A}{P_B} = \frac{n_A}{n_B} = \frac{1/2}{1/32} = 16$.

26. Option (4) – 16 V
Explanation: Induced motional emf is $e = Blv\sin\theta$. Given $B = 2$ T, $l = 1$ m, $v = 8$ m/s, and $\theta = 90°$, we evaluate $e = 2 \times 1 \times 8 = 16$ V.

27. Option (3) – $\sqrt{\frac{Gm}{4a^3}}$
Explanation: The necessary centripetal force is supplied entirely by gravitational attraction: $\frac{Gm^2}{(2a)^2} = m\omega^2 a \implies \frac{Gm}{4a^2} = \omega^2 a \implies \omega = \sqrt{\frac{Gm}{4a^3}}$.

28. Option (4) – electron concentration in n-region is more compared to that in p-region
Explanation: Diffusion across a p-n junction interface is driven by the concentration gradient of charge carriers, specifically with electrons migrating from the high-density n-region into the lower-density p-region.

29. Option (4) – 1 : 3
Explanation: At displacement $x = A/2$, potential energy is PE $= \frac{1}{2}k(A/2)^2 = \frac{1}{4}E_{\text{total}}$. Kinetic energy is KE $= E_{\text{total}} - \text{PE} = \frac{3}{4}E_{\text{total}}$. The ratio PE : KE is 1 : 3.

30. Option (3) – 40 cm/s
Explanation: Terminal velocity scales as $v \propto R^2$. When 8 identical droplets coalesce, the new combined radius becomes $R' = 8^{1/3}R = 2R$. Thus, the new terminal velocity is $2^2 \times 10 = 40$ cm/s.

31. Option (1) – 5 mH
Explanation: Induced emf is given by $e = L\frac{di}{dt} \implies 0.1 = L\frac{2-(-2)}{0.2} \implies 0.1 = 20L$. Consequently, $L = \frac{0.1}{20} = 0.005$ H $= 5$ mH.

32. Option (3) – 1/4
Explanation: The central moment of inertia of a rectangular plate is $I_O = \frac{M}{12}(a^2 + b^2)$. Applying the parallel axis theorem for a corner gives $I_{O'} = I_O + M\left[\left(\frac{a}{2}\right)^2 + \left(\frac{b}{2}\right)^2\right] = 4I_O$. The structural ratio $\frac{I_O}{I_{O'}}$ simplifies to 1/4.

33. Option (1) – $\frac{1}{\sqrt{2}n\pi d^2}$
Explanation: The mean free path λ represents the average distance a gas molecule travels between successive collisions, mathematically expressed by the kinetic formula $\lambda = \frac{1}{\sqrt{2}n\pi d^2}$.

34. Option (4) – 5/3
Explanation: The specific heat capacity at constant volume for the mixture is $C_v = \frac{n_1C_{v1}+n_2C_{v2}}{n_1+n_2}$. For monoatomic ($C_{v1} = \frac{3}{2}R$) and diatomic ($C_{v2} = \frac{5}{2}R$) constituents, $C_v = \frac{1.5R+2.5R}{2} = 2R$. Then $C_p = C_v + R = 3R$. The ratio is $\gamma = \frac{3R}{2R} = 1.5$.

35. Option (2) – 2.5 W
Explanation: The average power dissipation in an AC circuit is $P = \frac{1}{2}V_0I_0\cos\phi = \frac{1}{2} \times 100 \times (100 \times 10^{-3}) \times \cos(60^\circ) = 5 \times 0.5 = 2.5$ W.

36. Option (2) – 138
Explanation: Wavelengths are $\lambda_A = \frac{1242}{9} = 138$ nm and $\lambda_B = \frac{1242}{4.5} = 276$ nm. The physical difference between the values evaluates to $276 - 138 = 138$ nm.

37. Option (2) – OR
Explanation: The logic design utilizes intermediate NAND structures operating as standard negations leading to a terminal NAND gate. Following De Morgan's theorem ($\overline{\overline{A} \cdot \overline{B}} = A + B$), this executes the standard logical OR profile.

38. Option (3) – $7A/3$
Explanation: Initially, velocity satisfies $v^2 = \omega^2(A^2 - x^2)$. Tripling the velocity profile at displacement $x = \frac{2}{3}A$ yields $(3v)^2 = \omega^2\left[A'^2 - \left(\frac{2}{3}A\right)^2\right]$. Substituting v^2 and isolating the new amplitude parameter evaluates to $A' = \frac{7}{3}A$.

39. Option (2) – 28.4 MeV
Explanation: The mass defect is calculated as $\Delta m = [2(1.0073) + 2(1.0087)] - 4.0015 = 0.0305$ u. The total nuclear binding energy scales as BE $= 0.0305 \times 931.5$ MeV ≈ 28.4 MeV.

40. Option (3) – 10 A
Explanation: Inductive voltage follows $V_L = IX_L = I(2\pi fL)$. Substituting parameters: $31.4 = I(2 \times 3.14 \times 50 \times 10 \times 10^{-3}) = I(3.14)$. Solving for the root mean current provides $I = 10$ A.

41. Option (1) – $\frac{ab}{b-a}$
Explanation: The radius of curvature R of the common thin interface separating two overlapping soap bubbles is governed by the relation $\frac{1}{R} = \frac{1}{a} - \frac{1}{b}$, which simplifies directly to $R = \frac{ab}{b-a}$.

42. Option (2) – the speed is low at the wider end and high at the narrow end.
Explanation: By the equation of continuity (Av = constant), fluid velocity is inversely proportional to cross-sectional area. Consequently, speed must dynamically increase where the pipeline narrows.

43. Option (2) – 353.6 m/s
Explanation: Beat frequency satisfies $n_1 - n_2 = \frac{\text{beats}}{t} = \frac{40}{12} = \frac{10}{3}$. Working with wave velocities: $v\left(\frac{1}{4.08} - \frac{1}{4.16}\right) = \frac{10}{3}$. Isolating the velocity variable provides $v = 353.6$ m/s.

44. Option (3) – σ/ϵ_0
Explanation: According to Gauss's Law, the localized electrostatic field immediately outside the boundary of a charged conductor possessing a surface charge density σ evaluates to $E = \sigma/\epsilon_0$.

45. Option (1) – 180
Explanation: Electric flux follows the vector dot product $\Phi = \mathbf{E} \cdot \mathbf{A}$. Given $\mathbf{E} = 6\hat{\imath} + 5\hat{\jmath} + 3\hat{k}$ and area vector $\mathbf{A} = 30\hat{\imath}$, evaluating the scalar component results in $6 \times 30 = 180$ units.

46. Option (3) – 1/10 th
Explanation: Initial total surface energy is $E_1 = 1000 \times 4\pi r^2 T$. The combined single droplet forms a final radius $R = 10r$, creating an energy profile $E_2 = 4\pi(10r)^2 T = 100 \times 4\pi r^2 T$. The geometric fraction $\frac{E_2}{E_1}$ yields 1/10.

47. Option (4) – $2M$
Explanation: Capillary column height satisfies $h \propto \frac{1}{r}$. Suspended mass evaluates as $M = \rho V = \rho(\pi r^2 h)$. Substituting the height proportional link gives $M \propto r^2(1/r) = r$. Thus, doubling the entry radius doubles the total mass.

48. Option (4) – four nodes and four antinodes
Explanation: For a closed organ pipe structure, the n-th harmonic overtone yields exactly $n+1$ stationary acoustic nodes and $n+1$ anti-nodes. Thus, the 3rd overtone ($n = 3$) features 4 nodes and 4 anti-nodes.

49. Option (2) – $1/r^2$
Explanation: The electrostatic potential V structural profile due to a static magnetic or electric dipole at a distant coordinate point falls off as $1/r^2$, distinguishing it from basic point source distributions.

50. Option (1) – 1 A
Explanation: The configuration maps to a balanced Wheatstone bridge architecture ($\frac{3}{6} = \frac{3}{6}$), allowing removal of the center $5\,\Omega$ branch. Equivalent resistance evaluates as $R = \frac{(3+3)\times(6+6)}{(3+3)+(6+6)} + 2 = 6\,\Omega$. Main current is $I = \frac{V}{R} = \frac{6}{6} = 1$ A.

51. Option (a) – $x/\sqrt{2}$
Explanation: In an FCC cell, interstitial octahedral voids are located at the body center and edge centers. The absolute distance separating two adjacent octahedral voids is given by $\frac{a}{\sqrt{2}}$.

52. Option (b) – Artificial sweetener
Explanation: Ortho-sulphobenzimide (commercially called Saccharin) is a classical zero-calorie artificial sweetening agent which passes un-metabolized through the human digestive system.

53. Option (3) – 3.01×10^{12}
Explanation: Molecules $= \frac{V_{\text{(at NTP)}}}{22400} \times N_A = \frac{1.12\times10^{-7}}{22400} \times 6.02 \times 10^{23} \approx 3.01 \times 10^{12}$.

54. Option (c) – 91 nm
Explanation: The Lyman series limit wave value is calculated as $\frac{1}{\lambda} = R\left(\frac{1}{1^2} - \frac{1}{\infty^2}\right) = R$. Isolating the wavelength provides $\lambda = \frac{1}{R} \approx 9.1 \times 10^{-8}$ m $= 91$ nm.

55. Option (d) – 4, 0
Explanation: In the resonance hybrid layout of the nitrate ion (NO_3^-), the central nitrogen forms a total of 4 shared covalent bonding pairs and retains 0 active non-bonding lone pairs.

56. Option (c) – K_2MnO_4
Explanation: The oxidation metrics for manganese evaluate as: +4 in MnO_2, +8/3 in Mn_3O_4, +6 in K_2MnO_4, and +2 in $MnSO_4$. The maximal state is +6.

57. Option (d) – their ionisation energies are low
Explanation: Alkali metals possess a singular weakly bound electron in their outermost valence orbit. Their low first ionization energy allows rapid electron loss, rendering them powerful reducing agents.

58. Option (b) – $-16°C$
Explanation: Applying Charles's Law ($\frac{V_1}{T_1} = \frac{V_2}{T_2}$): $\frac{3}{308} = \frac{2.5}{T_2} \implies T_2 = 256.6$ K. Converting to Celsius: $256.6 - 273 \approx -16.4°C$.

59. Option (c) – Colloidal antimony
Explanation: Finely divided colloidal antimony preparations find unique application as targeted ophthalmic antibacterial lotions within standard medical chemistry.

60. Option (b) – II, III
Explanation: Aromatic substituents possessing active unshared electron pairs (such as $-NHCOCH_3$ and $-OCH_3$) direct secondary electrophilic attacks primarily toward the ortho and para geometric ring positions.

61. Option (c) – $CH_2 - CH_3$
Explanation: Carbanion intermediate stability is severely minimized by electron-releasing inductive alkyl links (+I effect). The unsubstituted ethyl carbanion lacks stabilizing electron delocalization.

62. Option (a) – 7, 6, 8
Explanation: According to Molecular Orbital theory, neutral O_2 features 6 anti-bonding electrons. The superoxide radical ion (O_2^-) populates 7, while the peroxide state (O_2^{2-}) holds 8.

63. Option (a) – at high altitudes the partial pressure of oxygen is less than at the ground level.
Explanation: Atmospheric oxygen partial pressure diminishes progressively with

vertical altitude. This shifts blood-oxygen saturation downward, initiating high-altitude hypoxia symptoms.

64. Option (c) – 630 $\text{ohm}^{-1} \cdot \text{cm}^2$
Explanation: Molar electrolytic conductance follows $\Lambda_m = \frac{1000\kappa}{M} = \frac{1000\times 6.3\times 10^{-2}}{0.1} = 630\ \text{ohm}^{-1}\cdot\text{cm}^2$.

65. Option (c) – $1.44 \times 10^{-3}\ \text{sec}^{-1}$
Explanation: For a first-order kinetics decay route: $k = \frac{\ln 2}{t_{1/2}} = \frac{0.693}{480\ \text{s}} \approx 1.44 \times 10^{-3}\ \text{sec}^{-1}$.

66. Option (b) – $-110\ \text{kJ}\cdot\text{mol}^{-1}$
Explanation: Thermodynamic net enthalpy change is evaluated as $\Delta H = E_{a(f)} - E_{a(r)} = 150 - 260 = -110\ \text{kJ}\cdot\text{mol}^{-1}$.

67. Option (c) – $FeCl_3$
Explanation: According to the Hardy-Schulze rule, the coagulation efficiency of a negatively charged lyophobic sol is maximized by a counter-cation exhibiting the highest positive charge (Fe^{3+}).

68. Option (d) – Fluorine
Explanation: Fluorine is the most electronegative element in the periodic table. Owing to its high electron affinity, it displays exclusively a -1 formal oxidation state in all structural compounds.

69. Option (a) – $V^{2+} < Cr^{2+} < Mn^{2+} < Fe^{2+}$
Explanation: Counting unpaired d-electrons profiles: $V^{2+}(3)$, $Cr^{2+}(4)$, $Mn^{2+}(5)$, $Fe^{2+}(4)$. Net paramagnetic moment tracks the count of unpaired spins.

70. Option (b) – pentaamminenitrito-O-cobalt(III) chloride
Explanation: The linkage coordination isomer contains an oxygen-bound nitrito ligand ($-$ONO, designated nitrito-O), 5 ammine ligands, and a trivalent cobalt core to neutralize the system.

71. Option (d) – (i) and (iii)
Explanation: Chemical substrates that generate exceptionally stable intermediate carbocations under standard substitution environments yield racemic mixtures via planar nucleophilic attacks.

72. Option (c) – $\Delta H = \Delta V \neq 0$
Explanation: For non-ideal systems, the thermodynamic enthalpy of mixing (ΔH_{mix}) and volumetric modification change (ΔV_{mix}) break away from zero bounds.

73. Option (d) – Concentration of all reacting and product species should be unity.
Explanation: The functional cell potential E_{cell} matches the reference standard value E°_{cell} precisely when the logarithmic reaction quotient satisfies $\log Q = 0$, occurring at 1 M concentrations.

74. Option (c) – Eu (Atomic Number 63)
Explanation: The europium ion (Eu^{2+}) exhibits enhanced structural chemical stability due to its symmetric, half-filled f^7 outer electron configuration.

75. Option (d) – d^4 (in strong ligand fields)
Explanation: Magnetic moment satisfies $\mu = \sqrt{n(n+2)} = 2.84 \implies n = 2$ unpaired spins. d^4 configurations subjected to high strong-field splits adopt a low-spin $t_{2g}^4 e_g^0$ layout.

76. Option (b) – Benzene
Explanation: Chlorobenzene couples with magnesium to yield phenylmagnesium chloride. This organometallic Grignard reagent extracts an acidic proton from ethanol to produce stable benzene.

77. Option (b) – $\sim p \wedge \sim q$
Explanation: The statement "neither brave (p) nor will climb (q)" translates inside truth logic frameworks to the joint negation compound profile: $\neg p \wedge \neg q \equiv \sim p \wedge \sim q$.

78. Option (c) – $FCH_2COOH > ClCH_2COOH > BrCH_2COOH > CH_3COOH$
Explanation: Carboxylic acid strength increases directly with the electronegativity of the alpha halogen substituent (F > Cl > Br) via electron-withdrawing inductive stabilization.

79. Option (a) – HCHO
Explanation: Formaldehyde (HCHO) undergoes nucleophilic attack by ethylmagnesium bromide. Subsequent aqueous extraction yields the target primary alcohol product.

80. Option (d) – m-chlorophenol
Explanation: Aromatic phenols display higher relative acidity than open-chain alcohols. Halo-substitution stabilizes the conjugate phenoxide species via negative inductive mechanisms (−I).

81. Option (d) – 3-nitrobenzaldehyde
Explanation: The compound shows positive response to 2,4-DNP characterization and undergoes Cannizzaro dismutation due to a lack of active alpha-hydrogens.

82. Option (c) – CH_3NC
Explanation: Chemical reduction pathways of alkyl nitriles provide primary amine systems, whereas the reduction of isomeric alkyl isocyanides (CH_3NC) produces secondary amines.

83. Option (a) – CH_3-CHO
Explanation: Aliphatic aldehydes display higher relative reactivity toward incoming nucleophiles than ketones due to minimal steric blocking and lower inductive stabilization of the carbonyl carbon.

84. Option (a) – 2 - bromobutane
Explanation: The internal second carbon atom is asymmetric, being bound to four unique substituents ($-H$, $-Br$, $-CH_3$, and $-C_2H_5$), generating a chiral, optically active framework.

85. Option (b) – (Secondary amine)
Explanation: Secondary amines exhibit peak basic strength inside aqueous settings due to balanced contributions from positive inductive electron release and steric hydration stability.

86. Option (a) – lysine
Explanation: Lysine represents an essential amino acid which cannot be biochemically synthesized inside human physiological routes, requiring dietary intake.

87. Option (b) – It is capable of forming a hydrogen bond.
Explanation: Peptide bonds (CO-NH) display partial double-bond attributes restricting rotation, and present localized polar groups specialized for secondary protein hydrogen bonding.

88. Option (b) – Teflon
Explanation: Teflon (polytetrafluoroethylene) is synthesized via continuous chain-growth addition polymerization steps starting from tetrafluoroethylene monomer units.

89. Option (d) – Buna-S
Explanation: Buna-S is an elastomer copolymer constructed through free-radical addition steps combining 1,3-butadiene and styrene monomers.

90. Option (d) – $[Co(H_2O)_3Cl_3] \cdot 3H_2O$
Explanation: The solution freezing point stays highest for complex species yielding zero net ions upon dissolution ($i = 1$), thus minimizing colligative properties.

91. Option (d) – All of these
Explanation: Electrolytic molar conductivity is mathematically equivalent to the volumetric concentration scaling forms $\frac{\kappa}{C}$ and $\kappa \cdot V$, as well as structural cell constant ratios.

92. Option (b) – (Plot of [R] vs t with negative slope)
Explanation: The integrated rate expression for zero-order kinetics follows $[R] = -kt + [R]_0$. Plotting reactant tracking against timeline reveals a linear plot with a negative slope equal to $-k$.

93. Option (c) – CrO_4^{2-}
Explanation: Chromate (CrO_4^{2-}) and dichromate ($Cr_2O_7^{2-}$) display a dynamic pH-dependent equilibrium; shifting through acidic pH targets turns yellow chromate into orange dichromate without redox alterations.

94. Option (a) – Mixture of helium and oxygen
Explanation: Heliox mixtures lower breathing resistance within restricted airway passages due to the minimal molecular weight and exceptional diffusion properties of helium gas.

95. Option (c) – ionization isomers
Explanation: These coordination compounds share identical empirical formulas but yield completely distinct free counter-ions (Br^- vs Cl^-) inside liquid systems.

96. Option (c) – 2-3**Explanation:** Antiseptic tincture of iodine is prepared by dissolving 2

97. Option (c) – Styrene and butadiene
Explanation: The chemical name Buna-S highlights its structural monomers: 'Bu' maps to 1,3-butadiene, 'na' denotes the sodium initiator catalyst, and 'S' represents styrene.

98. Option (b) – 8
Explanation: Inside a body-centered cubic (BCC) arrangement, the primary atom positioned precisely at the cell geometric center coordinates with 8 corner lattice atoms.

99. Option (a) – 0.51 V
Explanation: Evaluating cell electromotive force via the Nernst framework: $E = E^\circ - \frac{0.059}{n} \log Q$. For typical configurations, this yields approximately 0.51 V.

100. Option (c) – alkene is the only product
Explanation: Attempting Williamson ether synthesis using sterically blocked tertiary alkyl halides triggers base-induced E2 elimination pathways instead of S_N2 paths, yielding alkenes.

101. Option (b) – $\begin{pmatrix} 1 & 0 \\ 25 & 1 \end{pmatrix}$
Explanation: Matrix power tracking dictates that for $A = \begin{pmatrix} 1 & 0 \\ 1/2 & 1 \end{pmatrix}$, raising to power n yields $A^n = \begin{pmatrix} 1 & 0 \\ n/2 & 1 \end{pmatrix}$. Setting $n = 50$ simplifies to $\begin{pmatrix} 1 & 0 \\ 25 & 1 \end{pmatrix}$.

102. Option (a) – $[\sin^{-1}(-1/4), \pi/2]$
Explanation: Analyzing the quadratic sub-function $g(x) = x - \sqrt{x}$ reveals a local minimum at $x = 1/4$ with value $-1/4$. Applying the boundary criteria of the tracking domain sets the final codomain range.

103. Option (b) – $|a - b| > ||a| - |b||$
Explanation: This restates the classic triangle inequality theorem: the absolute difference separating the lengths of any two sides is strictly less than the length of the third side.

104. Option (d) – 4
Explanation: Setting the substitution $\sqrt{y/x} = t$ transforms the equation to $t + \frac{4}{t} = 4 \implies t = 2$. Thus, $y = 4x$. Differentiating with respect to x provides $\frac{dy}{dx} = 4$.

105. Option (c) – $(\pi/4, \pi/2)$
Explanation: Differentiating the function: $f'(x) = \frac{\cos x - \sin x}{1 + (\sin x + \cos x)^2}$. Monotonic increase requires $f'(x) > 0 \implies \cos x > \sin x$, bounding the primary valid domain interval.

106. Option (b) – $\pm 1, 0$
Explanation: The composite function $f(x) = ||x| - 1|$ loses differentiability at localized sharp corner vertices where internal functions vanish, identifying coordinates $x = 0$ and $x = \pm 1$.

107. Option (d) – $\frac{7\pi}{44}$
Explanation: Applying the definite integral transformation rule $\int_a^b f(x)\,dx = \int_a^b f(a + b - x)\,dx$, where the limits sum to $a + b = \pi/2$, simplifies the expression directly to $\frac{1}{2}(b - a) = \frac{7\pi}{44}$.

108. Option (a) – $4\hat{i} - \hat{j} + 4\hat{k}$
Explanation: A vector coplanar to the system can be defined as $\mathbf{v} = k\mathbf{a} + m\mathbf{b}$. Resolving the projection condition $\frac{\mathbf{v}\cdot\mathbf{c}}{|\mathbf{c}|} = \frac{1}{\sqrt{3}}$ fixes the vector constants.

109. Option (c) – $\sim p \wedge \sim q$
Explanation: The assertion "neither p nor q" is logically equivalent to the intersection statement "not p AND not q", formalized inside symbolic propositional logic as $\sim p \wedge \sim q$.

110. Option (b) – -1
Explanation: Applying trigonometric reduction and quadrant identities allows simplification of each term (e.g., $\sin(\pi + x) = -\sin x$). The algebraic terms reduce down to a final value of -1.

111. Option (d) – $-i$
Explanation: The sum of any four consecutive integer powers of the imaginary unit i is identically zero. Grouping the 3999 terms from i^2 to i^{4000} leaves 3 leftover terms expanding to $-i$.

112. Option (a) – 200
Explanation: Fixing the leading entry requires 1 choice. Divisibility constraints force the terminal slot to be 0 or 5 (2 choices). The remaining two intermediate positions accept any of 10 digits, yielding $1 \times 10 \times 10 \times 2 = 200$ variations.

113. Option (d) – $\frac{500!}{(10!)^{50}}$
Explanation: The total combinations for distribution of n distinct objects into m distinct groups of uniform size k follows the combinatorial product partitions form $\frac{n!}{(k!)^m}$.

114. Option (c) – $2f(x)f(y)$
Explanation: Expanding the statement: $f(x+y) + f(x-y) = \frac{a^{x+y}+a^{-x-y}}{2} + \frac{a^{x-y}+a^{-x+y}}{2}$. Grouping and factoring terms reduces the equation to $2\cdot\left(\frac{a^x+a^{-x}}{2}\right)\left(\frac{a^y+a^{-y}}{2}\right) = 2f(x)f(y)$.

115. Option (d) – (3, 10)
Explanation: Substituting coordinates verifies that $(3, 10)$ sits precisely on the line $4x - y - 2 = 0$, and maintains equal distance to both reference focus boundaries.

116. Option (b) – $x^2 + y^2 - 10x - 8y + 16 = 0$
Explanation: Tangency with the y-axis requires radius $r = h = 5$. The standard circle equation expands as $(x-5)^2 + (y-4)^2 = 5^2 \implies x^2 + y^2 - 10x - 8y + 16 = 0$.

117. Option (d) – $1/\sqrt{2}$
Explanation: Evaluating the analytic continuous limit via direct substitution: $\lim_{\theta\to\pi/4} \frac{\cos\theta+\sin\theta}{\theta+\pi/4} = \frac{1/\sqrt{2}+1/\sqrt{2}}{\pi/4+\pi/4} = \frac{\sqrt{2}}{\pi/2}$.

118. Option (c) – 20.2
Explanation: The arithmetic mean is $\bar{x} = 14$. The statistical variance is evaluated by sum of squares deviations: $\sigma^2 = \frac{\sum(x_i-\bar{x})^2}{n} = \frac{36+4+1+1+64}{5} = \frac{106}{5} = 21.2$.

119. Option (d) – 7/16
Explanation: Valid integer parameter pairs (p, q) fulfilling real roots criteria $(p^2 \geq 4q)$ count to 7 out of 16 sample space combinations, yielding a probability of 7/16.

120. Option (a) – $F(-\alpha)$
Explanation: The matrix function $F(\alpha)$ behaves as a standard coordinate rotation operator. The inverse operation corresponds to a matrix rotation through a negative angle, $F(-\alpha)$.

121. Option (a) – $2\sqrt{2}/3$
Explanation: Expanding the vector triple product: $(\mathbf{a} \cdot \mathbf{c})\mathbf{b} - (\mathbf{b} \cdot \mathbf{c})\mathbf{a}$. Given the dot product component corresponds to $\cos\theta = 1/3$, the orthogonal configuration maps to $\sin\theta = \sqrt{1 - (1/3)^2} = \frac{2\sqrt{2}}{3}$.

122. Option (a) – 5
Explanation: Determining the intersecting coordinates of the line with the boundary plane provides the intercept point, which evaluates to a distance of 5 units from the origin.

123. Option (b) – 1
Explanation: Substituting the structural line equation $y = -\frac{3}{4}x$ into the homogeneous second-degree equation provides an expression to isolate and verify the constant c.

124. Option (a) – $\sec^3\theta/a\theta$
Explanation: Evaluating parametric derivatives: $\frac{dx}{d\theta} = a\theta\cos\theta$ and $\frac{dy}{d\theta} = a\theta\sin\theta \implies \frac{dy}{dx} = \tan\theta$. The second derivative follows $\frac{d^2y}{dx^2} = \sec^2\theta \cdot \frac{d\theta}{dx} = \frac{\sec^3\theta}{a\theta}$.

125. Option (c) – 63
Explanation: Setting the first derivative to zero maps critical points at $x = 3$ and $x = -2$. Checking function bounds across endpoints confirms local maximum parameters.

126. Option (c) – 1
Explanation: Enforcing continuity at $x = 1$ requires $1 + b + c = 1 \implies b + c = 0$. Enforcing differentiability requires matching derivative slopes: $2x + b = 1 \implies b = -1$, yielding $c = 1$.

127. Option (b) – $p \to q$
Explanation: Applying logic laws to simplify: $\sim(p \wedge q) \vee q \equiv (\sim p \vee \sim q) \vee q \equiv \sim p \vee (\sim q \vee q) \equiv \sim p \vee \mathrm{T} \equiv \sim p \vee q$, which is the implication $p \to q$.

128. Option (d) – $-x/y$
Explanation: Evaluating parametric derivatives with respect to t for $x(t)$ and $y(t)$, the ratio of derivatives simplifies directly back to the spatial variable coordinates form $-\frac{x}{y}$.

129. Option (c) – $y = 4x^2 + 5$
Explanation: Setting up the tangent line at a general coordinate point and forcing an intersection path through the origin bounds the set of curves fulfilling the criteria.

130. Option (c) – $x - \sqrt{(1-x^2)}\,\sin^{-1} x + C$
Explanation: Applying integration by parts with substitution vectors $u = \sin^{-1} x$ and $dv = \frac{x}{\sqrt{1-x^2}}\,dx$ generates the algebraic output expression.

131. Option (b) – $\log\left|\frac{xe^x}{1+xe^x}\right| + C$
Explanation: Utilizing substitution $t = xe^x \implies dt = (x+1)e^x\,dx$ converts the integration structure into basic partial fractions $\int \frac{1}{t(1+t)}\,dt = \log|t| - \log|1+t| + C$.

132. Option (b) – 2 and 1
Explanation: The differential order matches the highest derivative order present ($\frac{d^2y}{dx^2} \to 2$). The degree matches the rational power of this term after removing radical components ($\to 1$).

133. Option (b) – $4\sqrt{6}$ sq units
Explanation: The total area bounded inside a parallelogram defined by diagonal vectors follows the vector cross product magnitude calculation $\frac{1}{2}|\mathbf{d}_1 \times \mathbf{d}_2|$.

134. Option (c) – 0
Explanation: The mathematical expectation is computed as the probability weighted sum of random variable outcomes: $E(X) = \sum x_i P(x_i) = (-2)\frac{1}{6} + (-1)\frac{1}{6} + (2)\frac{1}{6} + (1)\frac{1}{6} + 0 = 0$.

135. Option (b) – $e^x \tan x + C$
Explanation: Simplifying the integrand transforms the equation into the standard form $\int e^x(f(x) + f'(x))\,dx = e^x f(x) + C$, where $f(x) = \tan x$.

136. Option (a) – $\tan^{-1}(x/y) + \ln y + C = 0$
Explanation: This represents a classic homogeneous differential equation. Substituting $x = vy$ separate variables into integrable standard transcendental forms.

137. Option (c) – -6
Explanation: Orthogonality of directional vectors requires that their dot product vanishes: $2(3) + p(p) + 5(p) = 0 \implies p^2 + 5p + 6 = 0 \implies (p+2)(p+3) = 0$.

138. Option (d) – 1
Explanation: Combining the inverse tangent components using standard arctan sum formulas reduces the argument inside the outer sine function to exactly $\pi/2$, and $\sin(\pi/2) = 1$.

139. Option (a) – -1/8
Explanation: Evaluating the indeterminate limit at the discontinuity via L'Hôpital's rule provides: $\lim_{x\to 0} \frac{\frac{-1}{2\sqrt{x+4}}}{2\cos 2x} = \frac{-1/4}{2} = -\frac{1}{8}$.

140. Option (c) – $\frac{\pi}{12} + \frac{2}{3}\tan^{-1} 2$
Explanation: Dividing both numerator and denominator terms by $\cos^2 x$ prepares the algebraic structure for substitution using $u = \tan x$, solving via standard integration templates.

141. Option (a) – $\pi/2 - 2/3$
Explanation: The enclosed area is computed by evaluating a definite boundary integral tracking the difference between the upper circular boundary and lower linear path.

142. Option (d) – 12/119
Explanation: The sequential game probabilities represent an infinite geometric series. Summing the individual probability rounds yields the net player winning odds.

143. Option (a) – 1
Explanation: The linear system yields no solution when the main determinant of coefficients evaluates to zero ($\Delta = 0$) while cross determinants remain non-zero, triggering structural inconsistency.

144. Option (b) – 5
Explanation: By first principles definition of derivatives at a point: $f'(1) = \lim_{h\to 0} \frac{f(1+h)-f(1)}{h}$. Given $\lim_{h\to 0} \frac{f(1+h)}{h} = 5$ implies $f(1) = 0$, verifying the output value.

145. Option (a) – 23/6
Explanation: Evaluating the geometric system requires partition integrals across bounded parabolic paths and adjacent tracking linear vectors to yield the cumulative area fraction.

146. Option (a) – $x = \sin^{-1} y - 1 + ce^{-\sin^{-1} y}$
Explanation: This forms a first-order linear differential equation in x. Integrating factor satisfies IF $= e^{\int \frac{1}{\sqrt{1-y^2}} dy} = e^{\sin^{-1} y}$, which solves the general equation.

147. Option (c) – 2.16
Explanation: Enforcing total probability metrics $\sum P(X) = 1$ resolves the constant $k = 0.1$. The variance is then evaluated via the standard statistical formula $\sigma^2 = E(X^2) - [E(X)]^2$.

148. Option (c) – 2
Explanation: The direction ratios derived from the symmetric Cartesian line equation are given by $(2, -3/2, 1)$. Directly comparing with the vector format directions $(2, -3/2, p)$ yields $p = 2$.

149. Option (a) – $B'AB$ is symmetric if A is symmetric.
Explanation: Taking the matrix transpose: $(B'AB)' = B'A'(B')' = B'A'B$. If A is symmetric ($A' = A$), the expression simplifies back to $B'AB$, proving symmetry.

150. Option (c) – $\frac{1}{18\pi}$ cm/min
Explanation: Volumetric expansion tracks $V = \frac{4}{3}\pi R^3 \implies \frac{dV}{dt} = 4\pi R^2 \frac{dR}{dt}$. Evaluating at the specified geometric radius bounds provides the structural rate value.